

Crop Rotations and Their Impact on Soil Fertility

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Abstract: In the conditions of saline lands of the Republic of Karakalpakstan, in order to study the effect of crop rotation on soil fertility, field experiments were carried out.

Based on the results of the studies, it was found that in order to increase soil fertility, i.e. a positive humus balance towards the end is achieved by using alfalfa in the rotation as a cotton fore crop. With no alfalfa crop rotation, the humus balance by the end of the rotation is negative.

Keywords: Soils, fertility, saline, alfalfa, maize, cotton, nutrients, humus, humus balance, rotation.

Introduction. The irrigated soils of the Republic of Karakalpakstan are low fertile and saline. On such soils, it is necessary to apply annually techniques that increase soil fertility. Such techniques as the introduction of crop rotations, the use of organic, green manure and compost significantly increase soil fertility.

In recent years, the area under alfalfa crops has significantly decreased. Farmers prefer to use short rotational crop rotations like winter wheat : cotton : cotton. With such a scheme of sowing agricultural crops, an increase in soil fertility and productivity of cultivated crops is not ensured. In order to achieve an increase in soil fertility on such crop rotation schemes, after winter wheat, it is necessary to sow repeated and intermediate crops of legumes; otherwise, there is no increase in soil fertility and crop yields is ensured. In order to achieve an increase in soil fertility in such crop rotation schemes, after winter wheat, it is necessary to sow repeated and intermediate crops of legumes with the application of organic fertilizers at the rate of 20 t/ha.

In alfalfa crop rotation, there are not many costs involved. For three years of alfalfa standing in the soil, 15-20 t/ha of root and crop residues are left, and 200-300 kg/ha of biological nitrogen are accumulated. In addition, alfalfa is a valuable fodder crop for livestock.

Methodology of the research. The soils of the experimental plot are meadow-alluvial, the mechanical composition of the soil is medium saline. The area of each option is 240 m² located in one tier. The experiment was carried out in 2007-2015.

The following options were studied experiment. Option-1, cotton monoculture without fertilizer, option-2, cotton monoculture with fertilizer, option 3, 4 and 5, without alfalfa crop rotations according to the scheme 1:3:1:2, options 6 and 7, cotton-alfalfa crop rotations according to scheme 3: 4:1:2, options 8 and 9, cotton-alfalfa crop rotations according to the scheme 3:7. The duration of the experiment, depending on the scheme of crop rotation, is from 7 to 10 years.

Results and its discussion. Determination of the humus content in the soil and its changes in the soil and, depending on the crop rotation, the application of mineral and organic fertilizers, it was shown that before the experiment on the humus content, all the studied options did not have significant differences. In the layer 0-40 cm, its content was in the range of 0.650-0.680%. In the spring of 2019, i.e. after 3 years, in the variant with cotton monoculture without fertilizers, the humus content was 0.530%, i.e. decreased by 0.150% by weight of the soil compared with the original content. In the variant with cotton monoculture with fertilizer, this indicator was

0.610%, i.e. its content decreased by 0.060%, and with the introduction of organo-mineral fertilizers, it remained at the initial level or increased by 0.050%.

After a three-year alfalfa, the humus content increased by 0.140-0.180% compared to the initial content, it remained unchanged in the turnover of the alfalfa layer and was in the range of 0.810-0.830%.

The content of humus in the soil at the end of the rotation decreased to a greater extent in the cotton monoculture without fertilizers and in the 1:3:1:2 crop rotation without alfalfa. It should be noted that a particularly noticeable decrease in this indicator is observed in the first years of research with permanent cultivation of cotton. Stocks of organic matter over the years of research have decreased to a certain cotton and stabilized at the same level.

In the monoculture of cotton in the application with the application of mineral and organic fertilizers, the humus content also decreases, but due to manure, by an insignificant amount.

The research results show that in the absence of alfalfa crop rotation with the annual use of only mineral fertilizers, the humus content decreases by 20.7%, and with the annual use of mineral fertilizers and a single application of organic fertilizers - at the rate of 40 t/ha, the amount of humus over the years of research is stable or increases by 0.6 to 1.2% compared to initial condition.

Over the years of research, we have calculated the humus balance in the cultivation of cotton and other crops with different yields. For this, the gross humus reserve in the soil and the number of plants, the annual balance of humus, as well as for rotation, and calculated the rate of manure to cover the deficit or increase in humus, were determined.

The obtained data show that the balance of humus depends on the cultivated crops, the stock of humus in the soil, soil conditions and crop level.

The smallest amount of plant residues is found after cotton.

Therefore, more favorable conditions are created for the biological circulation of substances in the cultivation of fodder crops, which exceeds the root and stubble residues of cotton.

It can be noted that the use of mineral fertilizers significantly increases the yield of agricultural crops that carry the largest amount of nutrients, including humus.

As evidenced by the data, humus losses are directly dependent on the size of the crop, and the replacement of losses depends on the type of cultivated crops, i.e. under tilled crops (cotton, maize, sorghum), the humus balance is always negative, and under continuous crops (alfalfa, wheat), it is positive. When sowing wheat in 2013 (in a crop rotation of 3:4:1:2), a positive balance of humus in the soil is noted.

Balance of humus, \pm , t/ha

Number of the option	Years									Balance of humus at the end of rotation, \pm , t/ha	In pre accounting for manure, \pm , t/ha
	2006	2007	2008	2009	2010	2011	2012	2013	2014		
1	-0,41	-0,39	-0,35	-0,30	-0,28	-0,29	-0,28	-0,23	-0,23	-2,76	-73,6
2	-0,38	-0,32	-0,42	-0,34	-0,38	-0,39	-0,36	-0,08	-0,30	-2,97	-79,2
3	+0,10	-0,38	-0,36	-0,32	+0,02	-0,39	-0,06	-	-	-1,49	-39,7
4	+0,07	-0,38	-0,46	-0,37	-0,07	-0,43	-0,19	-	-	-1,83	-48,8
5	-0,33	-0,35	-0,46	-0,43	-0,11	-0,39	-0,39	-	-	-2,46	-65,6
6	-0,97	+1,40	+1,38	-0,54	-0,53	-0,53	-0,52	+0,09	-0,045	+1,27	+33,9
7	+0,95	+1,40	+1,36	-0,54	-0,54	-0,51	-0,48	-0,02	-0,37	+1,25	-33,3
8	+0,96	+1,37	+1,39	-0,55	-0,56	-0,53	-0,52	-0,44	-0,44	+0,68	+18,1
9	+0,98	+1,40	+1,37	-0,57	-0,54	-0,53	-0,54	-0,42	-0,41	+0,75	+20,0

By the end of the rotation in the 3:7 crop rotation, the initial fertility of the soil is preserved, i.e. simple reproduction, and in crop rotation 3:4:1:2 - extended reproduction of soil fertility. With monoculture of cotton without fertilizers and with fertilizer, as well as without alfalfa crop rotation, a negative balance of humus in the soil is observed.

In a crop rotation with a differentiated application of nitrogen norms and a one-time application of 40 t/ha of manure, a positive balance of humus in the soil was also achieved, which, in turn, has a positive effect on the level of raw cotton.

Conclusion. To increase soil fertility and crop yields, it is necessary to use crop rotation. At the same time, crop rotations should include alfalfa, a differentiated rate of nitrogen fertilizers, a one-time application of organic fertilizers at the rate of 40 t/ha, and one field of wheat after the fourth year of cotton cultivation.

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